WHAT IS CLAIMED IS:

1. A method comprising:

   a) obtaining at least one sample suspected of containing one or more target biomolecules;

   b) using the target biomolecule to generate pyrophosphate (PPi) by an enzyme-catalyzed reaction;

   c) using the PPi to produce light by a luciferase dependent process;

   d) accumulating the number of photons produced over a time interval; and

   e) detecting the target biomolecules in the sample.

2. The method of claim 1, wherein the luciferase dependent process comprises a bioluminescence regenerative cycle (BRC).

3. The method of claim 1, wherein PPi is converted to ATP.

4. The method of claim 3, wherein the formation of ATP from PPi is catalyzed by an enzyme selected from the group consisting of ATP sulfurylase, FMN adenyltransferase, adenylyl transferase and glucose-1-phosphate adenyltransferase.

5. The method of claim 1, wherein the target biomolecule is a nucleic acid or oligonucleotide.

6. The method of claim 5, wherein the target nucleic acid is amplified.

7. The method of claim 6, wherein the nucleic acid amplification technique is selected from the group consisting of polymerase chain reaction (PCR) amplification, strand displacement amplification, Qbeta replication, transcription-based amplification (TAS), nucleic acid sequence based amplification (NASBA), one-sided PCR, RACE (rapid

amplification or cDNA ends), ligase chain reaction amplification (LCR), 3SR (self-sustained sequence replication-reaction) amplification and rolling circle replication.

8. The method of claim 7, further comprising real time PCR amplification.

9. The method of claim 1, further comprising attaching an aptamer, a nucleic acid or oligonucleotide tag to a protein.

10. The method of claim 9, wherein the protein is a target biomolecule.

11. The method of claim 9, wherein the protein is an antibody, antibody fragment, FAb fragment, genetically engineered antibody, monoclonal antibody, polyclonal antibody or single chain antibody, fusion protein, binding protein, receptor protein, enzyme, inhibitory protein or regulatory protein.

12. The method of claim 11, wherein the protein binds to a target biomolecule.

13. The method of claim 12, further comprising measuring protein-protein binding.

14. The method of claim 1, further comprising measuring gene expression levels in a sample from a cell line, tissue, organ or subject.

15. The method of claim 3, wherein the concentrations of ATP and PPi reach steady state levels.

16. The method of claim 15, further comprising integrating the light output over time during the steady state.

17. The method of claim 15, further comprising adding between 0.01 and 10 attomoles of ATP or PPi to the sample before light is produced.

18. The method of claim 1, wherein the enzyme used to generate PPi is selected from the group consisting of a DNA polymerase, an RNA polymerase, a reverse transcriptase and a terminal transferase.

19. The method of claim 18, wherein the enzyme is thermostable.

20. The method of claim 19, further comprising using thermostable luciferase to generate light.

21. The method of claim 20, further comprising using thermostable ATP sulfurylase to produce ATP from PPi.

22. The method of claim 21, wherein the luciferase, ATP sulfurylase, DNA polymerase, RNA polymerase, reverse transcriptase and/or terminal transferase remain active after exposure to at least 90°C for at least 10 minutes.

23. The method of claim 22, wherein at least one percent of the initial activity of luciferase, ATP sulfurylase, DNA polymerase, RNA polymerase, reverse transcriptase and/or terminal transferase remains after exposure to at least 90°C for at least 10 minutes.

24. The method of claim 1, wherein sensitivity of detection is at least 0.1 attomol.

25. The method of claim 24, wherein 1000 target biomolecules can be detected in a sample.

26. The method of claim 1, further comprising determining the number of target biomolecules in the sample.

27. The method of claim 1, further comprising identifying the target biomolecules in the sample.

28. The method of claim 5, further comprising sequencing the target nucleic acid.

29. The method of claim 5, wherein the target nucleic acid is inserted into a vector.

30. The method of claim 5, further comprising detecting a single nucleotide polymorphism (SNP) in the target nucleic acid.

31. A method of nucleic acid sequencing comprising:

a) replicating multiple copies of a nucleic acid template molecule;

b) obtaining a complex signal from the nucleic acid replication;

c) deconvoluting the signal by statistical signal processing; and

d) determining the sequence of the template nucleic acid.

32. The method of claim 31, wherein the complex signal is obtained by BRC detection.

33. The method of claim 31, wherein the signal deconvolution comprises performing a Wiener solution analysis.

34. The method of claim 33, wherein the complex signal reflects a uniformly distributed time delay.

35. The method of claim 31, wherein the delay-time distribution is engineered to improve performance.

36. The method of claim 31, further comprising iteratively estimating N_j.

37. The method of claim 31, wherein the signal is deconvoluted using nonlinear techniques.

38. The method of claim 37, wherein the nonlinear techniques include maximum likelihood detection and/or sphere decoding.

39. The method of claim 31, wherein the signal sequence is modeled as the output of a hidden Markov model and deconvolution is performed using state estimation techniques.

40. A method comprising:

a) obtaining at least one sample suspected of containing one or more target proteins and/or peptides;

b) obtaining an assay mixture with at least one enzyme or substrate inactivated by peptide linkage;

c) exposing the sample to the assay mixture;

d) activating the inactivated enzyme or substrate;

e) generating pyrophosphate (PPi); and

f) producing light by a luciferase dependent process.

41. The method of claim 40, wherein the target protein is a protease and said protease removes the linked peptide from the inactivated enzyme or substrate.

42. The method of claim 40, wherein the inactivated enzyme is luciferase or ATP sulfurylase.

43. The method of claim 40, wherein the inactivated substrate is luciferin or APS.

44. The method of claim 40, further comprising measuring protein-protein binding.

45. The method of claim 40, wherein the luciferase dependent process comprises BRC.

46. A method comprising:

a) obtaining at least one sample suspected of containing one or more target nucleic acids;

b) generating pyrophosphate (PPi) by terminal transferase activity;

c) measuring the pyrophosphate generated; and

e) detecting the target nucleic acid.

47. The method of claim 46, wherein the PPi is measured by BRC assay.

48. The method of claim 47, wherein the terminal transferase reaction is terminated before the BRC assay.

49. The method of claim 47, wherein the terminal transferase reaction occurs simultaneously with the BRC assay.

50. The method of claim 46, wherein the terminal transferase is a thermostable terminal transferase.

51. A method for biomolecule detection comprising:

a) generating pyrophosphate in a biomolecule dependent process;

b) using thermostable ATP sulfurylase and luciferase to produce light from the pyrophosphate; and

c) measuring the light output to detect the biomolecule.

52. The method of claim 51, wherein the biomolecule is an oligonucleotide, polynucleotide or nucleic acid.

53. The method of claim 51, wherein the biomolecule dependent process comprises DNA polymerase activity, polymerase chain reaction amplification (PCR™), real time PCR, reverse transcriptase activity or terminal transferase activity.

54. The method of claim 51, wherein the biomolecule is a protein, peptide, antibody, antibody fragment, enzyme, receptor protein, ligand, substrate or inhibitor.

55. The method of claim 54, wherein the biomolecule is attached to an oligonucleotide.

56. A method comprising:

a) obtaining at least one sample suspected of containing one or more target nucleic acids;

b) adding labeled nucleotides to the one or more target nucleic acids with a thermostable terminal transferase; and

c) detecting the labeled nucleic acids.

57. The method of claim 56, wherein each type of nucleotide is labeled with a distinguishable label.

58. The method of claim 57, wherein the nucleotides are labeled with one or more fluorophores.

59. A method of biomolecule detection comprising:

a) attaching a target molecule to a substrate;

b) binding a first binding moiety to the target molecule;

c) binding a second binding moiety to the first binding moiety, wherein the second binding moiety is attached to a dextran or dendromer molecule labeled with oligonucleotides;

d) generating pyrophosphate by terminal transferase mediated addition of nucleotides to the oligonucleotides; and

e) detecting the pyrophosphate.

60. The method of claim 59, wherein the pyrophosphate is detected by BRC assay.

61. A system comprising:

a) one or more reaction chambers;

b) a microfluidic system;

c) one or more photodectectors

d) a thermostable luciferase; and

e) a thermostable ATP sulfurylase.

62. The method of claim 1, further comprising binding an aptamer to the target biomolecule.

63. The method of claim 62, further comprising detecting the bound aptamer.